Environmental Professionals

Army Environmental Policy Institute

Information Paper

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As environmental issues move to the forefront of political, social and economic agendas, it is necessary for the Army to consider the policy implications of recruiting and retaining sufficient numbers of qualified environmental professionals to meet increasing environmental responsibilities. This paper presents the broad topics relevant to the environmental professional issue including, changing demographics, changing requirements, changing approaches in education and training, and current efforts for and impediments to maintaining a highly qualified environmental staff. The issues are presented in a contractor prepared white paper and subsequent analysis of this white paper. This document also includes recommendations to improve the Army's ability to recruit and retain these professionals.

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Abstract

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The mission of the Army Environmental Policy Institute is to assist the Army Secretariat in developing proactive policies and strategies to address environmental issues that may have significant future impacts on the Army. The views presented in this document do not necessarily reflect the policies or views of the respective institutions of the contributors, reviewers, and staff.

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Section I

Section I Contents

1. Introduction

1.1 Purpose

The purpose of this paper is to provide an analysis of the current status of environmental professionals within the Army and to identify issues and opportunities related to recruiting and retaining sufficient numbers of qualified environmental professionals. Section II of this document is a white paper prepared by Scientific Applications International Corporation (SAIC) to address a documented trend that the availability of environmental professionals is currently and will continue to be an issue affecting organizations with environmental responsibilities. The white paper provides a sound analysis of this issue and presents many valuable recommendations for the Army to improve its ability to recruit and retain qualified professionals. The Army Environmental Policy Institute (AEPI) prepared Section I to present some additional information and concerns that the white paper did not address. Section I identifies factors that directly affect the Army including its definition of environmental professional, organizational structure, environmental awareness, command support, public opinion, and demographics. For each of these factors, the document identifies impediments to recruiting and retaining qualified professionals as well as provides recommendations to confront these impediments.

1.2 Approach

The Army Environmental Policy Institute charter includes a mandate to assess and analyze environmental trends. Pursuant to this mandate, AEPI researched and documented 41 trends which were presented to a group of environmental professionals from academe, industry and government during a workshop in August 1991. This list of trends was later published as Environmental Trends—Policy Implications for the U.S. Army. The workshop participants were asked to identify the four trends that would have the greatest significance to the Army. The topic of environmental professionals was one of those top four trends.

Following the workshop, SAIC was engaged to prepare white papers on each of the four trends. Upon receiving the white paper on environmental professionals, AEPI prepared a brief analysis to provide additional and supporting information. This document includes the AEPI analysis as Section I and the original white paper as Section II.

2. Analysis

2.1 What is an Environmental Professional?

The white paper (Section II) provides a solid analysis of the Army's civilian environmental professionals within the traditional approach that equates environmental professionals with environmental engineering. While environmental issues have historically been considered engineering issues, it is becoming more apparent that environmental issues are multidimensional and as such require a multidisciplined approach. There is a growing appreciation for the fact that many environmental problems need to be understood as ethical problems and not necessarily as technical or scientific problems (Brown, 1990). To address environmental challenges from the ethical standpoint requires professionals from a wide variety of backgrounds, including sociology, psychology, economics, political science, and communications among other disciplines.

Within the Army, the environmental program currently falls almost entirely within the engineering realm. Although environmental professionals can be found in many organizations throughout the Army, as the white paper points out, most are in the Corps of Engineers. This may not enable the Army to provide the best response to environmental concerns. "[The Corps of Engineers is not] in an organizational position to provide Armywide environmental leadership, or significant expertise in the nonengineering areas of the multidimensional, environmental arena" (Butts, 1991). The paper does include natural scientists in some of its discussion and does briefly address the interdisciplinary nature of environmental matters. The bulk of this discussion, however, is limited to the education process and how universities are responding to growing demands for multi- and interdisciplinary environmental programs. For the most part, the paper keeps within the historical, engineering perspective, which may not provide the best alternatives for the Army to deal with future implications and challenges in the environmental field.

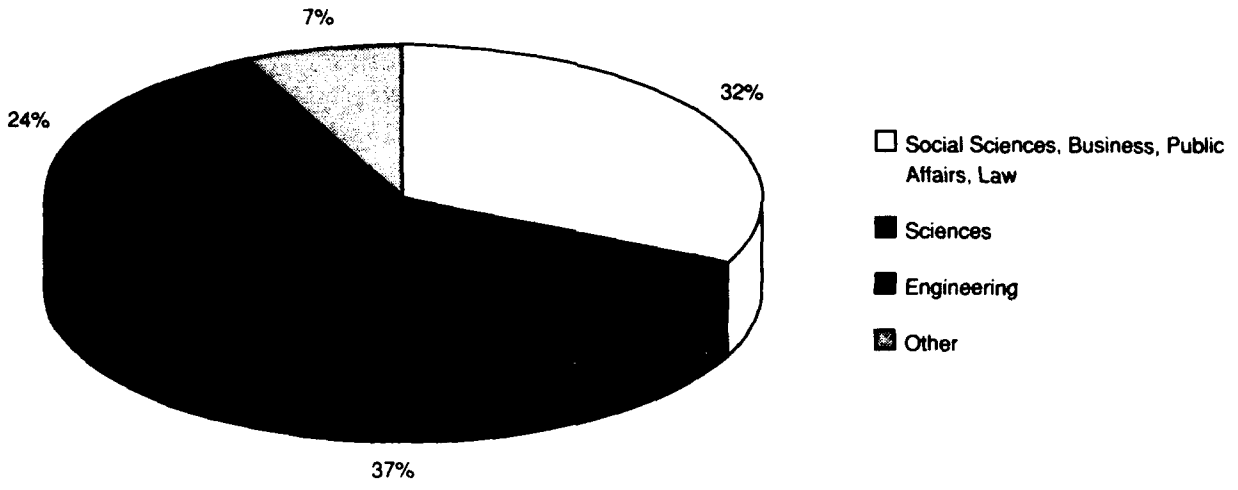
As the white paper points out, there may well be a shortage of engineers and scientists in the future. The number of degrees awarded at all levels in life and physical sciences as well as engineering have remained fairly steady since the early 1970s (U.S. National Center for Education Statistics, 1989). Yet, the environmental industry has grown from one that generated just $3 billion in revenues 20 years ago to a $132 billion industry with 814,000 employees (Ferrier, 1992). Additionally, approximately 30 pieces of environmental and environmental health legislation have been passed in the past 20 years (AEPI, 1992).

There is no doubt that the environment has achieved a significant place on the hierarchy of concerns within U.S. society. As the data show, there has been in increase in investment and an increase in regulations but not a proportional increase in the number of engineering and science graduates. One conclusion is that professionals with other types of degrees are filling the demands in the environmental field. This implies that within other organizations there may be a more multidisciplined approach to environmental issues.

As Figures 1-1 and 1-2 show, the employee mix at the Environmental Protection Agency (EPA) and SAIC are balanced with a diverse mix of people with different professional backgrounds. Again, within the Army most civilians on the environmental staff are scientists and engineers. A recent study of the environmental professionals at the Training and Doctrine Command (TRADOC) found that only about 12 percent of the environmental staff members had non-science and non-engineering backgrounds (Nemeth, 1991). Based upon the professional mix found within other environmental groups, the Army may want to look at a more diversified staff mix to meet its environmental responsibilities.

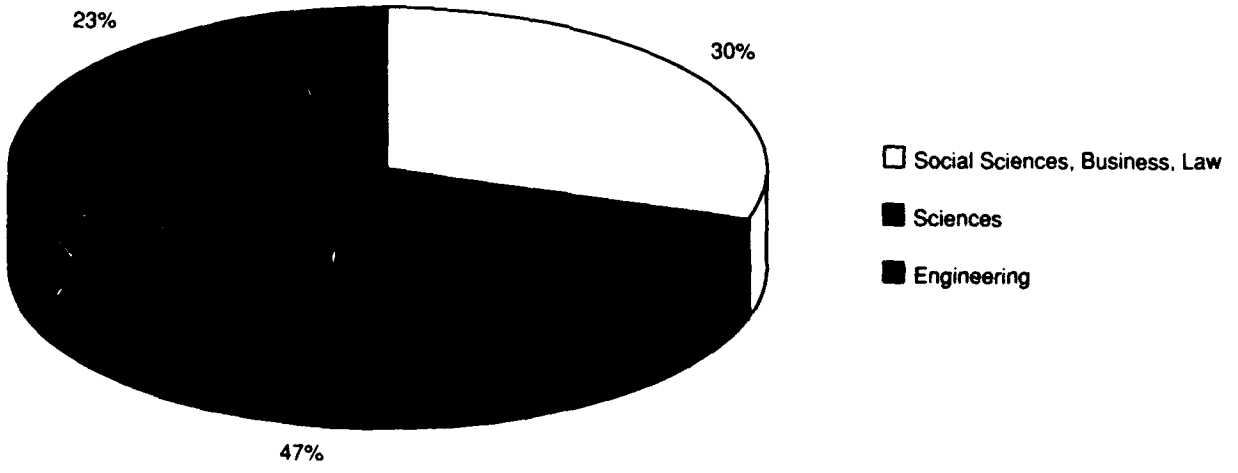
Another professional definition issue that the white paper does not address is the distinction drawn between environmental, and natural and cultural resource professionals. This division keeps the environmental management program fragmented and may significantly affect the Army's ability to

Figure 1-1 Employee Mix at EPA



Source: EPA, 1991

Figure 1-2 Employee Mix at SAIC



Source: SAIC, 1991

attract environmental professionals. It creates one more reason for professionals to doubt the sincerity of the Army's commitment to environmental issues. Missing is a concerted effort to integrate all environmental concerns within one organization that would encompass all environmental issues, including natural and cultural resources. Other professionals, including those from energy and entomology can also be considered environmental professionals and should be included in a consolidation.

2.2 Organization

The Army's organizational structure places environmental management within engineering channels. Locating environmental staffs within the Directorate of Engineering and Housing (DEH) is often a disability when the environmental staff try to fulfill their duties. "There is an inherent conflict of interest in having the environmental coordinator, who is responsible for ensuring that operators remain in compliance, being rated by the DEH, whose operations often create environmental problems" (Butts, 1991).

Being placed within DEH also does not allow environmental coordinators to manage. Rather, they become responsible for all environmental issues and concerns, and all operations look to the environmental coordinators and their staffs to do the work necessary to keep an installation in compliance. For the most part, Army environmental staffs are extremely dedicated and committed to helping the Army do the right thing. They strive to find new ways to do things and are eager to share their successes with others. But, they become frustrated with the bureaucracy and with the lack of status and resources granted to their positions individually and to their office as a whole.

It might be more beneficial from the standpoint of trying to attract and retain qualified people if environmental coordinators and their staffs were able to provide support to other installation coordinators to help them sustain compliance and introduce prevention initiatives within the scope of their individual missions. If coordinators or managers within all operational elements (e.g., training, acquisition, personnel) were responsible for environmental impacts within their mission, then the environmental coordinator could actually be a manager and provide necessary information and support to all installation operations. As long as the environmental coordinator must report to the DEH, he or she lacks the command level emphasis necessary to be truly effective. It has been suggested that the environmental coordinator should be given direct access to command levels, similar to the move safety made years ago (Butts, 1991). Another possibility is to combine the environment, safety and occupational health functions at the Major Command (MACOM) and installation levels, just as they are combined within the Department of Defense (DoD) and at Army Headquarters (Hartman, 1992).

Another organizational issue is the current hiring freeze. As the white paper discusses, this freeze has not helped the Army in its ability to maintain qualified environmental professionals. A dilemma exists because there are increasing environmental demands due to additional legislation and the Army's stated commitment to becoming an environmental leader, yet installations cannot hire the people necessary to do the job. This is a prime example of the bureaucracy creating an impediment to attracting qualified people.

Related issues within the bureaucracy are the mechanisms for filling positions. One issue that the white paper does not address is the fact that the personnel offices, responsible for hiring environmental professionals, in most cases have little or no knowledge of the environmental issues that the potential employee will need to address. The personnel offices have little or no basis for judging the relative worth of environmental skills, knowledge or accomplishments of applicants. This lack of knowledge has helped to create job standards, job descriptions and position requirements that are often too broad, or too specific to enable an optimal hiring mechanism to get the most qualified individuals into the open positions. For example, the Army often hires four year degree graduates to fill positions that would be more appropriate for someone with a technician background. This creates an atmosphere that leads to a high turnover rate for those positions.

Additionally, the grade and pay scales offered to employees are often not high enough to be an incentive for people to stay with the Army. The white paper provides substantial information on the pay rates for the various general service (GS) levels available to employees and how the government pay scales compare to the private sector. Most environmental positions outside of the Pentagon range from a GS 5 ($19,600) to a GS 11 ($35,500) grade level. These grade levels and subsequent pay scales are

not commensurate with the responsibilities placed upon the environmental staffs. Again, this creates retention problems.

AEPI research and analysis of audit findings show that the issue of environmental professionals is affecting the Army's ability to make its environmental programs effective. According to an AEPI draft report, audits found that Army MACOMs and installations had not adequately organized or staffed themselves to meet their environmental responsibilities. The report found that organization is as important as funding. The AEPI research also reported that environmental programs in the past suffered disproportionate staff and funding cuts (Jarrett, August 1992).

2.3 Awareness

Another important issue that the white paper does not address is the lack of environmental knowledge or awareness throughout the Army. An aware employee is informed about the impacts that his or her actions have upon the environment. An environmentally aware staff is sensitive to environmental issues and attempts to avoid causing environmental damage in their daily activities. All installation personnel, both military and civilian at all levels, need to be made environmentally aware. The latest draft of the Army environmental strategy includes several objectives for increasing overall awareness throughout the Army (U.S. Army, 1992).

If all civilian personnel were made more environmentally aware, job specifications might begin to reflect the actual level of education and training required to fulfill the position's responsibilities. This might alleviate the instances of having an unqualified person performing myriad tasks and trying to manage the program, while over qualified people are being placed in technician positions and therefore do not stay very long. If environmental staffs continue to bear a disproportionate burden for addressing environmental issues, qualified professionals will be less likely to enter Army employment and less likely to stay. Creating an atmosphere where all employees have a stake and a concern for the environment may help improve an installation's capabilities for recruiting and retaining environmental professionals.

Industry is finding that awareness issues can be extremely important in their day to day business. Many companies are implementing programs to ensure that all employees, not just those with environmental responsibilities, are aware of the company's environmental impact. For example, E. I. du Pont de Nemours & Company has developed a publication that provides guidelines for its employees to follow when creating a new product or process. Its purpose is to eliminate all waste and address environmental concerns at the design end rather than at the end of the pipe. The procedure has been well received and the company has found that, "Successful implementation of this procedure often results in a combination of environmental benefits and positive economic returns" (Kraft, 1991).

The academic opportunities offered to employees, as the Texas Instruments example in the white paper reflects, are extremely important, but so are the awareness activities. It is important that organizations emphasize both academic education as well as environmental awareness. Both work to help an organization attract and retain qualified people.

2.4 Command Support and Emphasis

Related to employee awareness and education is the issue of command support and command emphasis. The white paper limits its discussion to the civilian professionals and therefore does not devote much space to command emphasis. Environmental offices have often been perceived to be a problem standing in the way of training or other operations. Commanders, like many industry leaders, have believed that environmental issues were impediments to meeting mission requirements. It is difficult to separate the military and the civilian professionals because command emphasis can have a significant

impact on the overall environmental program at an installation or facility. Within the Army, the chain of command is extremely important. Without the military command emphasis, the environment continues to be delegated a secondary role in the minds of military and civilian personnel.

Creating a comprehensive awareness program is one way to help the Army leaders shift their paradigm to one that views the environment as contributing to and not a barrier to their success. Awareness helps create an environmental ethic throughout the Army that would ideally lead to the necessary levels of command emphasis. One step the Army could take to illustrate its commitment to environmental issues would be to create an environmental career track for its military professionals. This proposal has been discussed and rejected within leadership channels, but as the white paper recommends, it may be desirable to take another look at this possibility.

The Army could also hold commanders more accountable for their environmental record. Including environmental management factors in performance appraisals might provide the necessary incentive for commanders to grant their environmental staffs more support. Including environmental factors in all performance appraisals, not just the commander's, might also help raise overall awareness levels.

Another initiative the Army can take is to ensure that environmental committees are established at all MACOMs and installations, with the commanders as the head of these groups. The Commander's Guide to Environmental Management recommends that such a group include people from the legal, medical, and safety offices, as well as all sectors of the environmental program (COE, 1990). These committees give commanders direct exposure to the environmental concerns and issues that they must address. Again, this exposure hopefully leads to increased command emphasis on environmental issues.

All commanders at all levels need to embrace the environmental ethic and give it the emphasis it deserves on their installation or facility. Without command support and command emphasis, environmental professionals will continue to find themselves with no leverage and environmental concerns throughout the Army will continue to suffer. This issue creates a tremendous impediment to recruiting and retaining qualified individuals.

2.5 Public Opinion

Recent research found that public opinion strongly supports environmental protection (Jarrett, 1992). Environmental activism at local, state and federal levels is increasing. Installation commanders and their staffs must be prepared to deal with this trend. The Army will need qualified individuals at all levels and in a variety of fields to handle the increasing demands from the public and government for environmental protection and preservation. Without command support and emphasis, and general environmental awareness, the Army may not be able to meet the growing demands because it will not be able to find enough qualified people to do the job.

Environmental issues are becoming increasingly important to graduates entering the workforce. Graduates are interested in working for companies that are committed to lessening their impact on the environment. "In the future, in the eyes of environmentally aware students, high wages and good benefits will not compensate for unacceptable levels of pollution" (EcoSource, 1991).

The Army is having trouble recruiting because there is a negative public image about what and who the Army is. Granted, there will always be those who have a negative image of the military, but without substantial efforts, the negative perception will remain the predominant one. Past environmental practices and a lac. of proactive public relations have created this negative image. The Army has established many excellent environmental programs and has improved its environmental record tremendously, yet this information is not readily available to the public, or to potential employees. The Army as a whole has done little to communicate its good news about environmental initiatives. As the white paper points out, non-profit groups that often pay lower salaries than the government are inundated

with job applicants, while the Army struggles to recruit and retain sufficient numbers of environmental professionals. This suggests that salaries are not the primary driving force behind employment choices. The environmental groups have the image that makes employees feel as if they are providing a public service. The Army, if it improved its image could also attract qualified people to serve for the good of the environment.

To improve its image and gain more credibility with environmental professionals, the Army needs to develop a strong marketing campaign aimed at college and pre-college students. Many students still have the impression that to work for the Army you must be in the Army. There are programs and projects at local levels where the Army is actively involved with high school and college students. To meet its future needs, and to improve its image, there needs to be a much more concerted effort to develop outreach programs that highlight the many environmental career opportunities available within the military.

Another method for redefining its image is to pursue more cooperative agreements with public interest groups. Industry is finding it profitable and a good management move to cooperate with environmental groups to find solutions to environmental problems. The Army could learn from recent cooperative efforts that have emerged between such organizations as McDonalds and the Environmental Defense Fund, Natural Resources Defense Council and Pacific Gas & Electric, and the Audubon Society and Fuji Film (EcoSource, 1991).

2.6 Demographics

The white paper discusses changing demographics related to the issue of educating foreign students and provides the statistics on what the workforce is projected to look like by the year 2000. These changes may profoundly affect the Army's ability to meet its environmental responsibilities, and need to be thoroughly reviewed when developing recruiting and retention policies. The workforce is becoming much more diverse. By the year 2000 the majority of new entrants to the workforce will be women and minorities (Johnston, 1987). As more women enter the work place, employee expectations are likely to change. Issues relevant to attracting and retaining women will include parental leave, day care, flex time, job sharing, and working at home (Naisbitt, 1990). Under current policy, federal employees are not even granted maternity leave. This problem will not be unique to the Army or to the environmental field, but will affect all federal agencies and all types of activities. To maintain qualified professionals, the Army may need new policies and more flexibility in the work place.

Demographics also show more minorities entering the workforce. Traditionally, there have not been significant numbers of minorities graduating from science and engineering programs. A significant portion of minorities who go to college attend predominantly minority schools, which have few environmental programs (Chen, 1989). This is a tremendous portion of the workforce that the Army will need to tap in order to fulfill its environmental responsibilities. If environmental programs are expanded to include a more multidisciplined approach, this might lessen the need for more engineers and scientists. There will still need to be significant increases in the numbers of minority and female graduates in sciences and engineering to fill Army requirements, but there are minorities and women in other fields that may be well qualified to fill environmental positions within a multidisciplined approach.

Making matters worse, there are 2.5 million fewer college age persons in the United States today than there were just ten years ago (Baker, 1992). Experts anticipate a substantial dip in college enrollments with science and engineering suffering a proportionate drop. Recruiting women, minorities, and the physically handicapped, as well as increasing the general interest in science and engineering may help the Army obtain the professionals it needs (Life Systems, 1991). Attempts to recruit from other disciplines can also help alleviate the impact of the changing demographics.

Engineers are in high demand both in the public and private sector. Concentrating on recruiting engineers, when persons with other backgrounds may be as qualified, might hinder the success rate of the program and may affect retention rates. The Army needs to determine how much of the environmental program's day to day activities actually require engineering skills versus management or other types of skills. The Army may be more successful at recruiting and retaining professionals if it identifies those positions that currently require engineers and then determines if professionals with other backgrounds may be just as suitable.

3. Recommendations

The draft of the Army environmental strategy contains many objectives that directly address the issue of environmental professionals. The white paper presented here includes many recommendations that could help the Army achieve the objectives in the strategy. These recommendations could also tremendously improve the Army's recruiting and retention abilities. The first recommendation, to conduct a staffing study to determine long-term needs, is already underway. AEPI is currently pursuing this by looking at the necessity of developing strategic plans for recruiting professionals, addressing why professionals leave the Army, and identifying specific fields of emphasis for future Army staffing needs. These issues are all included in the various white paper recommendations. Industry and the EPA use recruiting plans as a necessary tool. Industry routinely keeps records of why people leave and use this information to improve recruiting and retention programs. This study will determine whether these types of initiatives might benefit the Army as well, and whether they would be feasible given current personnel rules and regulations.

Before adopting and implementing any recommendations, policy-makers should consider three overarching issues that will affect any recommendation's success. These major issues are job satisfaction, the potential for personal and professional development, and the image that accompanies the position.

Creating job satisfaction can be difficult within a large, bureaucratic organization like the Army. Within the Army, professionals at the installation level often have little input into the policies that they must implement. Things tend to move slowly and employees often do not see many results from the long hours they devote to their work. When developing any new programs, the Army must be cognizant that job satisfaction is very important in retaining qualified people. The white paper offers several recommendations to specifically address improving job satisfaction.

Additionally, many of the recommendations include ideas for increasing the opportunities for personal and professional development. These initiatives can make a tremendous difference in employee morale and can increase job satisfaction. For civilian personnel in environmental positions at the MACOMs and installations, training opportunities are often treated as a reward. Therefore, top level managers are usually the only professionals who get the chance to participate in organized training courses and sessions. Additionally, when money is tight, training budgets and the subsequent travel budgets are the first to be cut. Training and awareness should be used more fully to help everyone at all levels in their professional development. On the military side, the Army is a clear leader in providing personal growth opportunities for its employees. Some of the programs available, especially for training and pursuing higher education, could be used as models for developing similar civilian programs.

The third overarching element is the reputation of the organization and the respect granted to the employee. The white paper does not offer any recommendations that directly encourage a comprehensive marketing strategy to improve the Army's image. This may well be the most important aspect to the Army's ability to find and keep the professionals it needs. Until the Army addresses the organization impediments described in this paper, and makes a serious effort to sell its environmental program, it will continue to struggle in its attempts to hire qualified individuals. Until environmental staffs are granted the respect and authority necessary to reflect a true commitment to environmental leadership, the Army is likely to remain an unattractive prospect to potential employees.

4. Conclusion

Documented trends reveal that environmental issues will most likely remain a national concern and therefore society will continue to need qualified environmental professionals. As an environmental steward, the Army must continue to address its environmental challenges. To do so, the Army will need to ensure that it has the professional base required to meet its responsibilities. Factors affecting the Army's ability to maintain appropriate numbers of professionals include the current definition of environmental professional, organizational structure, environmental awareness levels, command support levels, public opinion, and changing demographics. The white paper recommendations provide a good basis for beginning to address this issue. Policy-makers, however, need to appreciate that job satisfaction, opportunities for personal and professional growth, and organizational and professional image will affect any recommendation that may be implemented and will need to be addressed to make successful changes in the status quo.

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Section II

ENVIRONMENTAL PROFESSIONALS

NATIONAL TRENDS, FORECASTS AND OPTIONS FOR THE ARMY

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Section II Contents

List of Tables

EXECUTIVE SUMMARY

As part of an on-going effort to analyze environmental trends, the Army Environmental Policy Institute (AEPI) has identified a shortage of environmental professionals as an important issue affecting the success of the Army Environmental Program. This white paper provides an initial analysis of this issue and highlights associated concerns and opportunities for the Army. The paper is based on a literature review and discussions with environmental managers at various levels within the Army.

The paper will show that the environmental marketplace for environmental professionals is projected to remain competitive through the 1990's. The intense demand for environmental engineering graduates will affect the Army's ability to compete with industry and government in recruiting these individuals. In addition, the percentage of engineering and science PhD graduates who are foreign nationals is increasing which may further restrict the pool of available candidates. Further complicating the environmental staff issue is the fast growth expected in new technologies and additional regulations which are anticipated. The Army must not only seek to hire the best qualified individuals but continually update the training of these individuals as new technologies and laws appear.

The number of colleges and universities offering programs in environmental science has increased substantially over the last several years, and the trend is expected to continue. The relatively new discipline of environmental engineering is receiving increased interest by students, yet the supply of graduates is not keeping pace with demand.

Recent trends in the employment of environmental professionals include growth in the environmental consulting industry and an increasing demand for environmental engineers in private industry and government. Increased public concern about the environment and continued growth of statutory and regulatory authorities are driving forces behind the demand for environmental professionals. The resultant shortage of professionals has spurred private industry to offer generous salaries and compensation packages to attract and retain qualified workers. Environmental interest groups are experiencing a reverse trend -- an increase in highly qualified applicants for a relatively stable number of job openings. Changing demographics will continue to influence the environmental workforce. The number of environmental professionals participating in national certification and registration programs is on an upward trend.

Army installations currently do not have the appropriate staffing levels to accomplish all of their environmental requirements. There is a lack of funding for environmental staff and access to appropriate training is inadequate. The Army needs effective incentives to attract and maintain qualified professionals. Retaining qualified professionals is difficult since salaries are not competitive with industry and there is not an established career track to guide the development and promotion of environmental professionals. Several options are presented in this paper to assist the Army in effectively recruiting, training, and retaining environmental professionals.

1. INTRODUCTION

1.1 PURPOSE

The purpose of this white paper is to provide an initial analysis of the problem of adequately staffing the Army with qualified environmental professionals. Only the civilian component of the Army has been considered. The paper will identify and analyze national trends affecting environmental education and the demand for environmental professionals and assess the significance of these trends regarding the Army's ability to recruit and retain qualified individuals.

In the United States, there are at least two registries for environmental professionals; the National Association of Environmental Professionals, and the National Registry of Environmental Professionals. These registries list people with education and experience in a broad array of disciplines, including the natural and physical sciences, the social sciences, the health sciences, law, and other subject areas needed to effectively manage a multitude of environmental issues.

Most of the Department of the Army civilians working as environmental staff throughout the Army are part of the Engineers and Scientists Career Field, managed by the Corps of Engineers. This career field is limited to those individuals with certain engineering and scientific backgrounds commonly found within Corps of Engineer organizations. Currently, there is no separate Career Field for environmental professionals in the Army.

For the purposes of this paper, an environmental professional is defined as an individual who has sufficient education and experience to qualify for a civil service position managed within the Engineers and Scientists Career Field. This definition is limited in scope to focus on the significant aspects of recruiting and retaining environmental professionals in the Army. Other individuals in the Army who have or could have a significant part to play in environmental program management are not included in the Engineers and Scientists Career Field but could qualify as an environmental professional under the registries mentioned above.

1.2 OBJECTIVES

1) Identify and analyze national trends and forecasts in environmental education and the employment of environmental professionals;

2) Discuss the significance of these national trends and future perspectives;

3) Provide a brief overview of environmental organization, programs, and management structure in the Army as it relates to employment of environmental professionals;

4) Review the adequacy of existing Army policies and practices in the areas of training, recruiting, and retaining environmental staff;

5) Outline short-term, mid-term, and long-term policy options for the Army to correct identified staffing problems and suggest means for implementing existing and recommended training and staffing policies.

1.3 METHODOLOGY

The methodology used for this paper was a combination of literature review and brief interviews with personal contacts. Documents and materials provided by the Army Environmental Policy Institute

were reviewed. Newspapers, periodicals, and numerous other references were examined for articles on national trends affecting environmental professionals and environmental education. Professional associations were contacted for information regarding the programs and services they offer. Key personnel at the Army Environmental Office and the Army Corps of Engineers were contacted to receive their insight on environmental staffing issues.

2.0 TRENDS AND FORECASTS IN EDUCATING AND EMPLOYING ENVIRONMENTAL PROFESSIONALS

2.1 TRENDS AND FORECASTS IN ENVIRONMENTAL EDUCATION

This section identifies and analyzes trends and forecasts in higher education in the environmental science and engineering disciplines. In particular, the trend toward more universities offering environmental programs and majors is discussed. Trends in awarding undergraduate and graduate degrees in the environmental science and engineering disciplines are examined, as well as changing demographics and new initiatives in environmental education. The significance to the Army of each of these national trends is also discussed.

2.1.1 Environmental Science Programs and Degrees

The number of colleges and universities offering programs and degrees in environmental science has increased substantially over the last several years. According to the College Entrance Examination Board, 317 U.S. colleges and universities (out of 2,900 surveyed) now offer majors in environmental science. In 1970, environmental science hardly existed as a recognized field on college campuses--only 5 universities in the nation offered graduate degrees in environmental science and ecology. Now, even departmental programs in environmental science are gaining popularity. The North American Association for Environmental Education estimates there are 125 to 200 universities offering environmental studies programs. These figures are projected to increase as students continue to demand more environmental courses (1).

Environmental studies programs come in two basic forms: multidisciplinary and interdisciplinary. Multidisciplinary programs offer relevant courses in many departments. In the interdisciplinary approach, disciplines are integrated within each course by faculty from different departments who team-teach it. Both programs have their strengths and weaknesses. Because multidisciplinary programs adjust individual courses rather than redefine entire disciplines, they can be adopted fairly easily, but too much responsibility is left upon the students to synthesize material from separate departments. Interdisciplinary courses, on the other hand, are more difficult to coordinate, and team-teaching is expensive.

Because environmental science does not fit the mold of a conventional academic discipline, environmental science majors and programs have not been easily adopted by most colleges and universities. It is difficult to establish a multi-disciplinary degree program that involves many colleges or departments within a university. In contrast to most academic disciplines which splinter knowledge of a single subject area into smaller pieces, environmental science attempts to link the knowledge of many disciplines, such as biology, engineering sciences, chemistry, mathematics, physics, sociology, economics, and political science.

The interdisciplinary nature of environmental science also creates problems for university professors in the field. Academic allegiance to a department demands research performance within that field. Professors who pursue interdisciplinary environmental work can put their chances for earning tenure in jeopardy. In the "publish-or-perish" world of academia, relatively few professional journals are devoted to environmental research, which makes publishing research results more difficult for environmental professors. Similarly, few professional associations offer networks for environmental professors (1).

Universities are also having difficulty finding support and funding for environmental programs and research. U.S. government funding to universities amounts to about $9 billion annually, but less than 2 percent goes to environmental biology and the study of human causes and consequences of environmental change (1). Environmental programs launched with seed money from foundations or corporations often cease when the initial funding expires.

Notwithstanding these hindrances to the success of environmental studies on university campuses, the number of students graduating with degrees in the field has been steadily increasing. The interdisciplinary nature of environmental science allows students to learn more than an abstract body of knowledge. They learn a process--to gather, sift, and evaluate information from a wide range of sources, to analyze complex problems, to detect bias, and to recognize the limitations of experts. Graduates in environmental science entering the work force are in increased demand to assist industry and government in solving complex environmental problems. The number of students graduating with degrees in environmental science is expected to continue to increase in the future.

2.1.2 Environmental Engineering Programs and Degrees

The American Academy of Environmental Engineers defines environmental engineering as "the professional application of scientific principles and technical practices to the protection and improvement of the health and well-being of humans and their surroundings. It involves the management and optimum use of air, water, and land resources, and the provision of facilities that will contribute positively to human health, comfort, and well-being." Within the range of activities included in that definition are water pollution control, air pollution control, hazardous waste and solid waste management, and water supply engineering. No academic program in environmental engineering is known to comprehensively embrace all facets of the field as broadly defined by the Academy. The diverse aspects of environmental engineering are unified, however, because all require a fundamental understanding of the chemical, physical, and biological phenomena controlling the quality of natural and engineered environments. These foundations are acquired at the undergraduate level and strengthened by basic and applied graduate coursework.

The Association of Environmental Engineering Professors estimates that universities produce one-third the graduates needed to fill as many as 5,000 environmental engineering openings a year. Only about 20 schools offer accredited programs leading to a bachelor's degree in the specialty of environmental engineering, and even though 22 others are considering programs, together they would still represent a small fraction of all schools offering traditional engineering degrees (2). It is more common for students to first obtain a bachelor's degree in one of the traditional engineering fields such as civil engineering and mechanical engineering and then to enter into a graduate program to specialize in environmental engineering. Approximately 115 universities in the U.S. currently offer graduate programs in environmental engineering. A listing of these universities is provided in Appendix A.

When environmental engineering was at its inception in 1965, only 150 university graduates obtained advanced degrees in the specialty. By 1980 the number of students graduating with advanced degrees in environmental engineering rose to 785. But as demand for environmental engineers continued to rise, the number of environmental engineering graduates declined slightly to 680 in 1989 (2).

A survey of 101 universities offering environmental engineering graduate programs was prepared for the Association of Environmental Engineering Professors in 1991 (3). The survey summarizes graduate student enrollment and degrees awarded in environmental engineering, including

areas of specialization. A total of 2,875 graduate students were enrolled for the 1991 spring semester, and 861 students graduated with advanced degrees in environmental engineering (717 master's degrees and 144 doctorate degrees). Table 2-1 lists the number of graduates receiving master's and doctorate degrees in 1990-91 by area of concentration.

As shown in Table 2-1, the fields of wastewater and hazardous waste were the most popular areas of specialization for environmental engineering graduates, yielding 263 and 200 graduates, respectively. Other areas of concentration included water, air pollution, solid waste, systems engineering, and other engineering (transport modeling, aquatic chemistry, etc.) These 861 environmental engineering graduates who entered the work force in calendar year 1990 are a valuable resource to the environmental industry which is in short supply of environmental engineers. The intense demand for environmental engineering graduates will adversely affect the Army's ability to recruit these individuals. The Association of Environmental Engineering Professors predicts that the supply of environmental engineers is not likely to meet demand until 1998 (2).

TABLE 2-1 ENVIRONMENTAL ENGINEERING GRADUATE DEGREES AWARDED 1990-91

Area of Concentration	Graduates
Water	138
Wastewater	263
Air Pollution	52
Solid Waste	29
Hazardous Waste	200
Systems Engineering	61
Other Engineering	118
Total	**861***

* Includes 717 master's and 144 doctorate degrees

Source: Ray, B.T., Southern Illinois University at Carbondale, 1990-91 Survey of Environmental Engineering Graduate Student Enrollment, prepared for the Association of Environmental Engineering Professors, July 19, 1991.

2.1.3 Improving Environmental Literacy

The National Environmental Education Act

The National Environmental Education Act was signed into law in early 1990. The Environmental Protection Agency established an Office of Environmental Education with a mandate to foster and enhance the environmental ethic in society by improving the environmental literacy of our youth and increasing public awareness of environmental problems. The program emphasizes four specific themes:

- Wise use of natural resources;
- Prevention of environmental problems;
- Importance of environmentally sensitive personal behavior;
- The need for additional action at the community level to address environmental problems.

The education program focuses on students from kindergarten to twelfth-grade, as well as college and university level training. The K-12 program has three broad objectives: to encourage states to increase the amount of environmental education, ensure that environmental issues are part of the environmental education curriculum, and to infuse environmental education topics into all basic subjects. The college-level program is aimed at improving teacher training by adding courses in environmental education to the degree curricula for the schools of education and liberal arts curricula, and by motivating students to pursue environmentally-oriented careers by helping to create internship opportunities in non-profit, public sector, and private sector settings. The program also includes community college and technical school students by developing two-year degree programs in environ mental specialties and by expanding two-year school training programs to provide environmentally-oriented worker training.

If the program proves successful, environmental literacy among the general public will improve and a greater number of students will have access to college environmental programs and internship opportunities. The emergence of initiatives such as the National Environmental Education Act indicates the federal government is being responsive to the need for an environmentally aware citizenry and an increased number of environmental professionals.

Integrating Environmental Issues into Other Academic Disciplines

There is a trend toward incorporating environmental topics into the general curriculum at universities to educate a broad student audience. The Tufts Environmental Literacy Institute (TELI) at Tufts University in Medford, Massachusetts is one such example. TELI, which opened in 1990, is chartered to "give all students a broad, continuing, and repetitive exposure to environmental issues throughout the curriculum." Participating professors from various Tufts schools and departments attend workshops and learn to blend environmental themes into their coursework. Allied-Signal, Inc. has provided $150,000 to sustain the TELI program through 1992, and the Environmental Protection Agency has made a similar grant (5).

The TELI program has the potential to affect educational thought at other universities throughout the U.S. and other nations. The curriculum outlines that emerge from TELI will be available to other university professors. High school teachers and professors from Canada and Brazil also have attended the TELI workshops and are formulating plans to establish similar programs at their schools and universities. In addition, professors participating in the program have been asked to write articles about their course revisions for publication in scholarly journals in their individual fields to inspire others (1). More university programs modeled after TELI can be expected to develop in the future.

Other university initiatives in the environmental arena are rapidly emerging. The University of Northern Iowa currently requires all junior-level students to take an environmental course to improve their understanding of environmental issues. At the University of Wisconsin, the new Campus Environmental Stewardship Initiative is pulling in students from a landscape architecture course to

design a restoration and management plan for campus woodlands (1). Environmental initiatives and programs can take time to become institutionalized and to make an impact, however, the long-term result will be more environmentally literate university graduates. This trend will have a positive impact on the Army's environmental awareness campaign in the future, since an increasing number of new Army recruits can be expected to have a general understanding of environmental concepts.

Even such traditional schools as business are realizing the need to improve environmental literacy among their students. As recently as 1986, American business schools were devoid of courses on how to manage environmental issues. The current trend, however, has been for university business schools to include environmental management courses as electives and to integrate environmental issues into classes on such established subjects as marketing and accounting. Approximately 25 U.S. business schools now teach environmental management. The Corporate Conservation Council, an arm of the National Wildlife Federation, recently gave $300,000 to help business schools at Boston University, Loyola University of New Orleans, and the University of Minnesota craft environmental management curricula (4). The result of this innovative trend will be more M.B.A. graduates who are environmentally literate.

2.1.4 Changing Demographics in Higher Education

The number of Ph.Ds awarded in sciences and engineering experienced renewed growth between 1978 and 1988. According to the National Academy of Sciences (NAS) Government-University-Industry Research Roundtable, however, the growth is due primarily to a rising enrollment of foreign students (6). At Carnegie Mellon University, for instance, approximately 60 percent of the graduate students in science and engineering are foreign (7). An Office of Technological Assessment (OTA) Report on the Defense Technology Base points out that, while the number of U.S. citizens obtaining graduate degrees in science and engineering stabilized in the late 1980s, the number of foreign student graduate degrees in these fields has increased. The share of engineering Ph.D. degrees awarded to foreign students with temporary U.S. visas grew from 16 percent in 1958 to nearly 45 percent in 1985. The share of Ph.D.s awarded foreign students in the natural sciences also grew from 14 percent to 24 percent by 1988 (8).

Statistics also show that less than half of these science and engineering graduates remain in the U.S. after graduation (8). In the decision of whether or not to return to their native country after graduation, foreigners weigh such factors as living conditions and career development and promotion opportunities, and some are finding the prospects better in their native country. Countries such as Taiwan and Korea are aggressively recruiting their nationals to return by paying their airfare back, offering free housing, and giving them money and interest-free loans (7). Yet, even if foreign nationals choose to stay in the U.S., the decision depends on U.S. immigration policy. The U.S. grants 500,000 permanent visas annually, but 96 percent are given on the basis of family relations and only 4 percent are given based on skills or demonstrated labor shortages. This has generated a backlog among those foreign graduates who want to stay, with waiting periods of two to four years (7). The situation is not good for U.S. companies who have come to depend upon foreign born engineers. At Texas Instruments, for example, 25 percent of the Ph.Ds in research labs are foreign born, and of the 1000 resumes in research and development that Texas Instruments processes every year, only 42 percent are from U.S. citizens (7). The need exists to encourage more U.S. students to pursue advanced degrees in science and engineering to fill the present and future demand.

The Office of Technological Assessment (OTA) 1989 Report of Higher Education for Science and Engineering stated that many policy-makers worry that the supply of new engineering and science graduates will not meet future demands due to changes in demographics (9). The Army may not be able to take advantage of the increase in foreign PhD graduates if restrictions exist for hiring foreign nationals due to national security, or other reasons. The Army may, therefore, find it increasingly difficult to recruit advanced engineering and science talent as the supply of engineering and science PhD graduates with U.S. citizenship continues to decrease in the future.

2.1.5 Expanded Funding for Environmental Education and Research

The National Science Foundation

The federal government can have a tremendous influence on higher education through its funding awards. Federally-funded financial aid programs and research and equipment grants are critical for many institutions. The National Science Foundation (NSF) plays the largest role of any government organization influencing higher education in science and engineering. The NSF provides graduate fellowships and encourages curriculum innovations and lab and instrument improvements. It also gives incentive awards , provides facility and undergraduate research grants, and supports programs aimed at enhancing science education (8).

Graduate fellowships offered through the NSF are available to individuals through a formal application process. Applicants are selected based upon academic qualifications and references. Graduate fellowships are awarded for a three-year period. The amount of the award for the 1991-92 academic year was $14,000 for tuition and $7,500 for non-tuition allowance (10). Opportunities exist for the Army to take advantage of graduate fellowships and other programs offered through the NSF.

National Institutes for the Environment

The National Institutes for the Environment (NIE) is a proposed new federal granting agency that would be charged with the primary objective of sponsoring mission-oriented fundamental and applied environmental research, education, and training. Current government agencies with environmental functions are not focused on research and education, and they support few competitively awarded grants. The NIE would complement existing research efforts by sponsoring collaborative efforts across scientific disciplines.

Similar to the National Institutes of Health within the Department of Health and Human Services, the NIE would be a non-regulatory science funding agency that has a protected budget and independent control of its own research and training agenda. The NIE would promote environmental literacy by supporting environmental education in schools and universities, as well as for the general public. The NIE would also play a central role in educating and training future environmental professionals by strengthening environmental research and education in colleges and universities. Grants would be competitively awarded by panel review to support multidisciplinary task forces and individual investigators in educational institutions, research organizations, and state research agencies. In addition, the NIE would create a National Library for the Environment to improve the accessibility and quality of environmental data available to scientists, the public, and policy makers (11).

The Committee for the National Institutes for the Environment (CNIE) is trying to lobby support for the NIE proposal as it moves through the Congressional approval process. The CNIE estimates that

the approval and implementation process for the NIE proposal will take at least 5 years (12). The NIE holds promise for providing a much needed leadership role for environmental research, education, and training in the future.

Establishing the NIE could have a positive effect upon the Army's future recruiting efforts. The Army, like other governmental and private sectors, currently has difficulty in recruiting research scientists for environmental research. Through its support and funding, the NIE would help nurture research efforts and increase the number of environmental researchers available to government, industry, and the military services.

2.1.6 Continuing Education

Continuing education can be of substantial value to environmental professionals wishing to stay current on environmental issues, regulations and technologies. It is especially important for engineers to continue their education throughout their careers because their value to their employer depends on their knowledge of the latest technology. The pace of technological change varies by engineering specialty and industry. The technological advances in environmental engineering are expected to accelerate in the next decade (8).

Continuing education courses are offered through numerous agencies, private firms, university and college extension programs, and professional organizations. Professional continuing education centers offer a wide variety of courses in science and engineering to assist professionals in keeping abreast of new and changing technologies, regulations, and issues.

Most professional organizations sponsor conferences, workshops, courses, and publish journals to allow their members to stay current with all aspects of their profession. Professional organizations which may be of interest to Army environmental professionals include the American Chemical Society, American Society for Testing and Materials, American Institute of Chemical Engineers, and the National Association of Environmental Professionals. Government agencies, universities, and private environmental consulting and engineering firms sponsor numerous courses and workshops on such subjects as technology, waste management, regulations, and safety (8). Many opportunities exist for Army environmental staff to continue their education through participating in such conferences and workshops.

2.2 TRENDS AND FORECASTS IN EMPLOYMENT OF ENVIRONMENTAL PROFESSIONALS IN PRIVATE INDUSTRY AND GOVERNMENT

Recent trends in the employment of environmental professionals include:

- Growth in the environmental consulting industry and an increasing demand for environmental professionals in private industry and government.
- Continued growth of statutory and regulatory authorities is a driving force behind the demand for environmental professionals.
- The resultant shortage of professionals has spurred private industry to offer generous salaries and compensation packages to attract and retain qualified workers.
- Environmental interest groups are experiencing a reverse trend -- an increase in highly qualified applicants for a relatively stable number of job openings.

- Changing demographics will continue to influence the environmental workforce.
- The number of environmental professionals participating in national certification and registration programs is growing.

2.2.1 Environmental Consulting

Boasting an annual growth of 19 percent in 1990, environmental consulting is the fastest growing field in the environmental industry. In 1990, companies paid more than $12 billion to U.S. environmental consulting firms; 10 years ago industry revenues were only $1 billion (13). Reasons for the boom in the consulting industry include increased public awareness of industry activities, the increasing complexity of pollution control laws, and the escalating costs to clean up contaminated sites. The market for environmental consulting is expected to continue to thrive. The Environmental Business Journal projects average annual growth in environmental consulting to exceed 16 percent during the 1991-96 period (2).

Consulting firms are hiring environmental professionals of many different disciplines and are especially interested in environmental engineers. Environmental engineering encompasses such specialties as air pollution control, resource recovery, hazardous waste management, asbestos abatement, water utilities, and solid waste management. There are currently only 25,000 to 50,000 environmental engineers in the nation, and they are in much demand. The shortage of environmental engineers has produced serious competition among companies vying for their expertise, and employee turnover rates among firms in the industry average 17 to 22 percent annually (2). At the Carnegie Institute of Technology in Pittsburgh the head of the civil engineering department reports receiving several calls a week from employers looking for environmental engineers. "At least four jobs come calling for every one available person," reports one New York recruiter who specializes in environmental jobs (14). Government agencies have been affected by the shortage of environmental engineers as the private sector lures away government engineers with lucrative employment offers.

The employment opportunities for environmental scientists and engineers will continue to expand over the next several years. Revenues generated in 1991 by various segments of the environmental industry ranged from $1.9 billion for instrument manufacturing to $30.9 billion for solid waste management. The fastest growing environmental engineering markets are air pollution control and resource recovery which are projected to grow at an average annual rate of 15 percent and 14 percent, respectively, over the 1991-96 period (2). Table 2-2 lists the 1991 revenues and projected average annual growth rates (1991-96) for the various segments of the environmental engineering industry.

2.2.2 Compensation for Environmental Professionals

Salaries for recent graduates in environmental sciences and engineering are lucrative. Bachelor of science graduates in environmental engineering at Renesselaer Polytechnic Institute in Troy, New York will command annual salaries of approximately $40,000. Students in the master's program for environmental engineering at the University of Southern California can expect to receive salaries of $42,000 to $50,000 upon graduation (2).

According to the 1990 Environmental and Hazardous Waste Industry Compensation Survey, salary increases for employees of environmental firms continue to outpace other industries. The survey, sponsored by the American Consulting Engineers Council's Hazardous Waste Action Coalition, included responses from more than 12,000 employees in 73 firms. The survey showed employees of

TABLE 2-2 GROWING MARKETS IN ENVIRONMENTAL ENGINEERING

Engineering Segment	1991 Revenue (In billions $)	Projected Avg Annual Growth 1991-1996 (%)
Environmental Consulting	14.2	16
Air Pollution Control	6.3	16
Resource Recovery	19.7	15
Analytical Services	2.3	14
Hazardous Waste Management	15.1	14
Waste Management Equipment	10.3	12
Water Infrastructure	15.4	10
Instrument Manufacturing	1.9	10
Solid Waste Management	30.9	8
Environmental Energy Sources	1.9	8
Asbestos Abatement	4.3	4
Water Utilities	12.0	4
Total	**120.1**	

Source: Environmental Business Journal, April 1991.

environmental firms averaged a 6.4 percent salary increase in 1991, while employees in other types of engineering and construction firms averaged only a 5.6 percent increase. Top environmental engineering executives average $108,500 in salary and bonuses. Those with nine years of experience average $53,100, and those with two to three years average $33,200 (15).

In addition to competitive salaries, bonuses and other perks are common incentives offered by environmental engineering firms in the private sector. Table 2-3 illustrates who is typically eligible for bonuses in environmental engineering firms and the average amount of a bonus as a percentage of an employee's salary.

The Army is competing directly with government and private industry for the limited supply of environmental scientists and engineers. Private industry is able to offer lucrative salaries and generous bonuses to environmental professionals which the Army is presently not in a position to match. Therefore, the Army can expect to have continued difficulty in recruiting and retaining environmental professionals for the next several years until supply catches up with demand.

TABLE 2-3 BONUSES BY JOB CATEGORY IN ENVIRONMENTAL ENGINEERING FIRMS

Job Category	% Eligible for Bonus	Avg Bonus as % of Salary
Chief Executive Officer	98	30
Top Manager	97	18
Middle Manager	83	7
Field Operations	24	3
Professional	53	3
Marketing	90	12
Laboratory	34	5

Source: William M. Mercer, Inc., 1990.

2.2.3 Environmental Interest Groups

While private industry and government are experiencing shortages in the supply of environmental professionals, the opposite seems to be true for environmental interest groups. Greenpeace, the international environmental group, received 7,000 applications in 1989 for 250 jobs in the United States. The World Wildlife Fund received 6,000 applications in 1989 for 40 openings in its Washington headquarters. The high number of applications is particularly surprising considering starting salaries at such environmental interest groups are usually between $14,000 and $25,000 a year (16). This trend indicates that for many environmental professionals job satisfaction and contributing to national environmental problem solving outweighs the relatively low salaries offered by these organizations.

Environmental interest groups have been attracting high-quality, as well as high volume, job applicants. Such groups report that the number of applicants with special degrees and training have increased and that some applicants have Wall Street experience and law degrees. The 1990 summer internship class conducted by the Environmental Defense Fund attracted students with backgrounds in biochemistry, environmental sciences, forestry, and environmental law. The Environmental Defense Fund sees people in the legal community becoming more interested in foregoing lucrative careers in the private sector for doing work that is more important socially (16).

The growing popularity of environmental interest groups indicates an increasing desire to participate in solving national environmental issues. This aspect of job satisfaction is becoming more important to environmental professionals who are seeking socially important work that is contributing to the environmental welfare of the nation. The Army should capitalize on this trend in its recruiting efforts by marketing its goal of becoming a leader in pollution prevention and environmental compliance, restoration, and conservation. The Army can improve retention of its existing environmental staff by encouraging participation in regional and national environmental conferences. Army environmental

staff should also be encouraged to take part in environmental professional organizations and contribute to professional journals.

2.2.4 Government Agencies

Staffing at the Environmental Protection Agency (EPA) increased from 14,750 in 1980 to over 19,000 in 1991, resulting in increased capabilities for promulgation of regulations and enforcement activity (36). As a national organization, the Army must be in a position to monitor and respond to ongoing statutory and regulatory actions at the federal level and in all fifty states. As a result, Army environmental staff can become overwhelmed with the array of regulations. Increased enforcement activity by EPA increases the workload of Army environmental staff charged with maintaining compliance.

The EPA itself is also subject to the shortage of environmental professionals. The emissions standards division has experienced trouble in hiring enough qualified environmental engineers to write implementing regulations for the Clean Air Act. The division chief approached the problem by hiring and training engineers from other specialties. The drawback is that it may take up to two years for the engineers to grasp the intricacies of the specialty of air pollution (2).

Amid the boom in environmental laws, a severe shortage has developed among people trained to help with monitoring and remediation. Government agencies are seeking graduates to monitor polluters and help carry out widespread cleanup projects, for which the Department of Energy alone has earmarked $38 billion from 1993 to 1997. The shortage is especially acute among senior personnel. Some government cleanup projects have come to a standstill because of the difficulty of keeping engineers to direct them. As a result of the engineer shortage, some government agencies have even waived the normal immigration requirements to hire foreign air pollution engineers still awaiting their green cards (2).

2.2.5 Changing Demographics in the Labor Force

Every other year, the Bureau of Labor Statistics develops projections of the U.S. economy, including projections of the labor force by age, sex, and race and cultural origin. The labor force projections prepared for the 1990-2005 period show a slower rate of increase than the rate which prevailed over the 1975-90 period--1.3 percent, compared with 1.9 percent growth for the previous 15 year period. The rate of growth increased from the 1960's until the 1980's, as the baby-boomers entered the labor force. In contrast, the 1980s were a period of slower rates of labor force growth because a significant portion of the baby-boomers were already in the labor force and the new labor force entrants were being drawn from the smaller cohort born between 1965 and 1979--the so-called "baby-bust" group. The projections show a slowdown in labor force growth, with the projected 1990-2005 growth rate being slower than in any comparable period of the last 30 years (17).

The overall slowing of labor force growth is only one change projected for the 1990-2005 period. Another important change is the number of 16- to 24-year-old youths in the labor force. Table 2-4 shows annual rates of change in the labor force, by selected characteristics. While declines in the number of youth in the labor force will continue for a few more years, about 1996, this group will begin to increase gradually, and by 2005, is projected to be 2.8 million larger than in 1990. Consequently, the worry about lack of entry level workers, which was of concern in the late 1980's and early 1990's, should ease considerably, if not disappear entirely, as we progress through this decade (17).

TABLE 2-4 ANNUAL RATES OF CHANGE IN THE LABOR FORCE

Category	Actual 1975-1990	Projected 1990-2005
Men	1.3	1.0
Women	2.8	1.6
16- to 24-year-olds	-.4	0.8
25- to 54-year-olds	3.0	1.1
55 years and older	0.5	2.4
White	1.7	1.1
Black	2.5	1.9
Asian and other	6.2	3.8
Hispanic	5.9	3.8
Total, civilian labor force	**1.9**	**1.3**

Source: U.S. Bureau of Labor Statistics, 1991.

The increasing diversity of the U.S. labor force has been an important development of the past several decades, and BLS projects a continuation of this trend. The composition of the labor force over the 1990-2005 period is expected to continue to shift toward a somewhat higher percent of women (from 45.3 percent in 1990 to 47.4 percent in 2005). Women's growing share of the labor force occurs even though the data show women to be slightly less than one-half of the projected labor force entrants. Women's growing share of the labor force comes about, therefore, because they are expected to constitute less than 43 percent of labor force leavers over the 1990-2005 period (17).

Another important continuing change in labor force diversity is among minority groups. Blacks, who represented 10.7 percent of the labor force in 1990, are projected to account for 13.0 percent of labor force entrants over the 1990-2005 period. Hispanics, who represented 7.7 percent of the labor force in 1990, are projected to account for 15.7 percent of labor force entrants from 1990 to 2005. Also, the Asian and other category, which was 3.1 percent of the labor force in 1990, is expected to account for nearly 6.0 percent of the entrants over the 15-year projection period. Of course, the offsetting trend is that while white non-Hispanics were 78.6 percent of 1990's labor force, they are projected to represent 65.3 percent of entrants, but nearly 82 percent of the labor force leavers over this period. Consequently, the U.S. labor force is expected to be much more diversified in 2005 than it was in 1990 with regard to sex, race, and ethnicity (17).

However, blacks and Hispanics continue to be under-represented in professional occupations such as lawyers and judges, scientists, engineers, and consultants. As a particular example, the major

national environmental organizations have had a difficult time recruiting minorities. National organizations such as the Natural Resources Defense Council, the Wilderness Society, and the Sierra Club cite a scarcity of black or Hispanic people among the pool of trained environmental specialists as the cause. As of February 1990, the Natural Resources Defense Council had five minority professionals among its staff of 440, and the Sierra Club's 250-member staff included only one Hispanic person and no blacks or Asians among its professionals. In response to the situation, eight national environmental groups formed an Environmental Consortium for Minority Outreach to actively recruit minorities and attempt to remedy the hiring imbalance (18).

2.2.6 Certification Programs and Professional Registrations

Another trend affecting the environmental workforce is the increasing availability of, and participation in, certification and professional registration programs for environmental professionals. Several specialized certification titles, such as Certified Industrial Hygienist and Certified Hazardous Materials Manager, are available to qualified technical specialists. However, only two programs on the national level focus on the "environmental professional" in general. These are the environmental professional certification program offered by the National Association of Environmental Professionals and the professional registry program offered by the National Registry of Environmental Professionals, which are discussed in further detail below.

National Association of Environmental Professionals

The National Association of Environmental Professionals (NAEP) is a multi-disciplinary nonpartisan professional society dedicated to the promotion of ethical practice in the environmental field and recognition of the environmental profession as a distinct career path. NAEP was incorporated in 1975 and currently has over 2,600 members worldwide. NAEP provides a valuable resource for environmental professionals, providing a forum for information sharing and professional networking. The association sponsors annual conferences and publishes a quarterly journal and a bi-monthly newsletter (19).

NAEP sponsors a voluntary certification program for its members. The certification program is designed to provide recognition to those environmental professionals who are specifically qualified through a combination of education, experience, and proven accomplishments. Applicants for certification as an Environmental Professional must be a general member of NAEP. The primary conditions of eligibility are a bachelor's degree and a minimum of nine years of applicable professional environmental experience, five years of which must be in a position of responsible charge and/or responsible supervision. Applicants must submit required information (including a resume, references, educational transcripts, and five essay responses) to a review committee for consideration of approval. Five functional areas for certification are available. These specialized areas are described in Appendix B.

Certification as an Environmental Professional entitles the member to publicize that fact by using the designation "C.E.P" after his or her name, by stating such on resumes/other documents, and by applying the certification seal on appropriate technical and decision documents. This affirms to the public that the certified member is an environmental professional who has been recognized by his or her peers to possess special qualifications by education, experience, and accomplishment (19).

Approximately 200 NAEP members have been certified as Environmental Professionals. The certification program has been refined and modified over the years to adjust to the needs of the evolving profession. Today, many engineering and planning firms and governmental agencies are accepting

NAEP certification as the equivalent to registration as a professional engineer or certification by other well established and recognized professional societies (19).

National Registry of Environmental Professionals

Established in 1990, the National Registry of Environmental Professionals (NREP) is a non-profit organization that provides professional registration to qualified individuals. The purpose of NREP's programs is to promote legal and professional recognition of individuals possessing education, training, and experience as environmental managers, engineers, technologists, scientists, and technicians--and to consolidate that recognition in one centralized source. NREP publishes the "Official Registry of Environmental Professionals" which is a listing of all persons possessing an NREP professional registration. The registry is made available to federal, state and municipal regulatory officials, industry, and other interested parties. Approximately 16,100 environmental professionals are currently registered with NREP (20, 21).

NREP professional management registrations are a close parallel in design to the programs offered by state governments for professional engineers. NREP's programs provide steps so that individuals may receive professional recognition of their skills and knowledge as they advance along their career path. Registration titles range from Registered Environmental Manager (highest level) to Associate Environmental Professional (entry level), and special registration titles are available for those with specific expertise in compliance auditing, property assessment, and laboratory analysis. Appendix C defines the various registration levels available and their associated educational and work experience requirements. To ensure that individuals remain current in knowledge and practices, professional registrations are issued for a specific length of time and all persons are required to provide proof of acceptable continuing education or training prior to reissuance of their registration (20).

3.0 CURRENT RECRUITMENT, TRAINING, AND RETENTION POLICIES, PRACTICES, AND DEFICIENCIES

3.1 OVERVIEW OF ARMY ENVIRONMENTAL PROGRAM MANAGEMENT

Army Secretariat

The Assistant Secretary of the Army for Installations, Logistics, and Environment is responsible for environmental programs including environmental policy for the Army. Within the Office of the Assistant Secretary, the Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health provides direction and management oversight of all environmental programs.

Army Staff

On the Army Staff, the Office of the Chief of Engineers has functional staff proponency for environmental matters. The Chief of Engineers also serves as the Commander of the U.S. Army Corps of Engineers. Under the direction of the Chief, the Assistant Chief of Engineers accomplishes the Army Staff function and works closely with the Office of the Assistant Secretary and the Deputy Assistant Secretary to develop environmental policy and to plan, program, and budget the resources needed to execute environmental programs Army-wide. Within the Office of the Chief of Engineers, the Army Environmental Office provides the staff support to administer these functional responsibilities.

Corps of Engineers

The U.S. Army Corps of Engineers is a major Army command (MACOM) which manages the Army's environmental restoration program and serves as the DOD executive agent for the restoration of all formerly used Defense sites. The Corps of Engineers has many other environmental management responsibilities as part of its civil works activities. The Corps supports all other MACOMs and the Army staff in executing environmental programs through its world-wide civil works organization.

Director of Engineering and Housing

At the installation level, environmental programs are usually managed by the Director of Engineering and Housing (DEH). Environmental professionals working under the DEH include both military and civilian personnel.

3.2 RECRUITING ENVIRONMENTAL STAFF

3.2.1 Army Recruiting Policies

The Army currently does not have any official written policy regarding recruitment, training, and retention of environmental staff. An environmental strategy document entitled, "U.S. Army Environmental Strategy into the 21st Century," which is in the draft stage of development would include such policy statements. The document is being prepared under the direction of the Secretary and Chief of Staff of the Army and will form the basis for all future planning, programming, and budgeting decisions for the Army environmental program. Implementation and tracking of the strategy will be reported annually to the Secretary and Chief of Staff of the Army (22).

The December 1991 draft version of the environmental strategy document describes four key building blocks that provide the foundation for all Army activities. These building blocks are people, resources, communication, and management and organization. The people foundation block focuses on total Army personnel awareness and quality environmental professional staff. The draft strategy document states, "Trained, competent professional staff at all levels are essential to manage and execute an excellent environmental program. This includes creating appropriate positions, numbers, and adequate grade levels, then recruiting, training, and retaining quality environmental professionals for those positions" (22).

3.2.2 Army Recruiting Practices

Recruiting activities are restricted by the current Department of Defense (DoD) personnel hiring freeze. DoD has been under the hiring freeze since January 1990. The freeze restricts replacement hiring to one new hire per four positions opened through attrition (23). Personnel freezes at the installation level have resulted in a net loss of environmental personnel in the face of expanding requirements.

Active recruiting for environmental professionals within the Army is limited. No active recruiting efforts are currently made at the Army Corps of Engineers headquarters office. Advertising is used selectively for specialists when a position is open (23). The Army Environmental Office is not engaged in any recruiting efforts at present, even though staffing is generally felt to be inadequate for the workload (24). Announcements and the established engineers/scientist careers program are used to facilitate hiring at the Army Environmental Office.

3.2.3 Army Recruiting Deficiencies

There is no special career field in the Army for environmental professionals. Thus, current hiring practices can result in choosing an unqualified person for an open environmental position. A general definition of an "environmental professional" is so broad that persons with as diverse backgrounds as a sanitary engineer and a botanist could be expected to perform the work of managing a broad array of environmental programs at the installation level. Establishing a career program (discussed further in section 5) that would specify minimum qualifications for each environmental position would eliminate this problem. An environmental career field could also delineate clear paths for career advancement. The opportunity for career advancement is an attractive incentive for potential new recruits.

The grade level structure for many environmental positions is inadequate and makes recruiting difficult. In many cases salaries are not commensurate with job duties and are markedly lower than those being offered by private industry. GS levels and salaries are discussed further in section 4.3.2 (Retention Incentive Practices).

Salaries and advancement opportunity, however, are not the only factors that potential new recruits consider. The image that the Army projects and the value of work to be performed are also important considerations. Environmental interests groups, for example, currently enjoy a favorable image and public admiration. Individuals who work for these interest groups are viewed as "concerned environmentalists" contributing to national environmental problem solving. The challenge of their work and the satisfaction that they receive from it outweigh the typically low salaries offered. The Army may be able to attract new recruits more effectively by promoting its dedication to becoming a national leader in environmental stewardship and restoration and its need for qualified environmental professionals to achieve this goal.

Another hindrance to recruiting environmental staff is that no mechanism exists to identify military personnel who may posses expertise in an environmental discipline. Anywhere from 100 to 1,000 military personnel may have environmental experience which is not evident from the person's title or educational degree, and personnel records generally do not reflect such information (25). Adding a skills indicator for environmental experience or education to the Army's current classification system would capture this information and could be used to identify environmental talent from existing military personnel. These individuals could be put to use as a supplemental resource for environmental management. This option is discussed further in section 5.

3.3 ENVIRONMENTAL EDUCATION AND TRAINING

3.3.1 Army Education and Training Practices

An Army Environmental Training Master Plan (AETMP) is being developed to answer the long-term environmental training needs for the Army. The AETMP will use the systems approach to training (SAT) which seeks to minimize costs and resources spent on training by analyzing and prioritizing potential task training areas. Those task areas which are determined to require training based on importance and complexity of the task are then targeted for development and implementation.

In addition to long-term training needs, the AETMP also defines near-term environmental training projects. These near-term projects include distributing an environmental training directory; establishing an environmental repository for lending information; developing exportable courses; creating an environmental coordinators handbook series; and conducting environmental awareness research (26).

Environmental training programs for Army personnel are conducted by the Army Logistics Management College (ALMC) and the Huntsville Division, U.S. Army Corps of Engineers. Environmental awareness is also integrated into management training at the Defense Systems Management College at Fort Belvoir, the Command and General Staff College at Fort Leavenworth, Kansas, and at the Senior Service College. The U.S. Army Corps of Engineers headquarters office has an active training program for senior staff that includes cross-detailing work with the U.S. Environmental Protection Agency (23).

Specific training required for the hazardous materials/hazardous waste program is also available from a variety of civilian and military organizations. The Army Logistics Management College provides eight hazardous materials/hazardous waste-related courses which satisfy regulatory requirements for supervisors, environmental managers and hazardous waste handlers. The Judge Advocate General offers an environmental law course and provides instruction on leader liability issues. Fort Benning provides a Hazardous Materials Incident Management Course for First Responders that is open for Army-wide use. The Huntsville District, U.S. Army Corps of Engineers, teaches detailed cleanup and restoration skills. The TRADOC/AMC schoolhouses provide some hazardous materials/hazardous waste awareness training through selected MOS training and Pre- and Installation Command courses (27).

The U.S. Army Corps of Engineers has developed a Master Intern Training Program targeted to develop the skills of recent college graduates. The program offers two tracks for training environmental interns--a natural resources track and an environmental sciences track. Interns are developed from typically a GS-5 entry level to "full performance level" in their field. The program outlines for interns all the necessary knowledge, skills, or abilities that are required for job performance. Training programs generally range from 24 to 36 months in duration (28).

The U.S. Army Corps of Engineers has also developed an Army Civilian Training and Education Development System (ACTEDS) for Career Program 18 (engineers/scientists in natural resources and construction). Environmental staff are included within Career Program 18. The ACTEDS serves as a roadmap for professional development by allowing staff to identify where they currently stand within the hierarchy and what position they are aspiring to achieve, and by outlining the training necessary for the desired advancement (28).

3.3.2 Army Education and Training Deficiencies

Civilian training activities for environmental professionals are not well organized. The civilian training program lacks coordination and does not provide adequate training and professional development guidance for environmental staff. Currently only a few mid-level management staff are selected to participate in annual update training programs, and the bulk of training is focused on senior staff (GS-13 and above). Technical staff, especially junior technical staff, are generally not included in management training at civilian institutions.

Another deficiency in the training system for environmental staff is that consolidated listings of specific training requirements are generally not available. Commanders and supervisors are typically unaware of the myriad of training requirements for their personnel and consequently do not adequately resource, manage, and supervise their training efforts (27). A small environmental staff may also face time constraints to complete numerous environmental training requirements while juggling a demanding workload.

3.3.3 Education and Training Examples from Industry

Education and training are taking on unprecedented importance as a means for keeping companies abreast of new technological advancements and as an incentive benefit for employees. For example, Texas Instruments, an electronics manufacturing company, offers a significant educational assistance benefit. If an employee wants to pursue a bachelor's, a master's, or doctorate degree in a field that meets company needs, Texas Instruments will pay from 90-100 percent of the cost of tuition and books, and managers will work with the employee on scheduling. To make this benefit more convenient to employees, Texas Instruments has a computer system at its Dallas facility that allows employees to go to school at the plant site. All they do is turn on the television to a satellite broadcast for coursework and requirements. The company also has worked diligently at setting up regular courses on-site. If there are enough employees interested in an evening course being offered by a local college or university, a professor will teach the class on-site (29).

Companies like Texas Instruments have found that the payoff comes as the employees are learning. Texas Instruments has been experiencing a problem with availability of people with advanced degrees so it is worth the company's time and investment to allow their employees the time and opportunity to pursue higher education. Texas Instruments recognizes the efforts of employees by factoring their education into how they are being promoted (29).

3.4 STAFF RETENTION INCENTIVES

3.4.1 Army Retention Incentive Practices

Monetary compensation, benefits, and job satisfaction are all factors that contribute to retention of environmental professionals. The Army bases monetary compensation upon a combination of salary and a bonus incentive program and provides additional benefits (health care, vacation, pensions) for its

personnel. Job satisfaction is a less explicit factor which can vary from individual to individual based upon personal goals and values. Common factors in job satisfaction for environmental professionals are personal accomplishment, responsibility and authority to affect change, challenging work environment, and contributing to national environmental problem solving.

Salaries for federal white-collar employees are fixed according to a general schedule (GS) pay structure. The GS pay structure follows an ascending grade and step level progression according to an employee's education, experience, and tenure. The GS pay structure applies to all white-collar employees in all disciplines with few exceptions, such as GS 11 engineers who receive accelerated pay. Table 3-1 lists total employment figures and mean salaries for general schedule employees at each grade level as of March 1991. At the Department of the Army level, most environmental positions are grade level GS 13 and above. As of March 1991, the mean salary for GS 13 was $51,485. At installation level, most environmental staff positions are GS 9 through GS 12, corresponding to mean 1991 salaries of $29,247 and $43,018, respectively. These salary levels are approximately 12 to 19 percent less than conservative private industry figures. Environmental scientists and engineers with two to three years experience average $33,200 in the private sector, and those with nine years experience average $53,100 (15).

Pay raises for general schedule employees averaged 4.1 percent in 1991 (30). This annual increase is 36 percent less than private industry figures. According to the 1990 Environmental and Hazardous Waste Industry Compensation Survey, salary increases for employees at 73 environmental engineering firms averaged 6.4 percent in 1991 (15).

Incentive Awards -- A federal agency may pay up to $25,000 to an employee for a suggestion, invention, or other contribution that reduces costs or improves government operations or services. The Incentive Awards Program, overseen by the Office of Personnel Management, was established because the government believes that employees deserve special recognition for performance excellence and creativity. Cash awards that recognize exceptional performance or a significant achievement are an important part of the program. Approximately 600,800 employees receive a performance award each year for overall high-level performance. The average award is $735. In addition to these awards for overall performance, approximately 200,000 special act or service awards are granted each year. Special act or service awards recognize contributions such as work on a special project, performance exceeding job requirements on a particular assignment or task, a scientific achievement, or an act of heroism (30).

3.4.2 Army Retention Incentive Deficiencies

No formal environmental career field exists for environmental staff in the Army. Personnel performing environmental duties are classified under the Engineer/Scientist Career Field that is managed by the U.S. Army Corps of Engineers (USACE). USACE Huntsville Division is working to establish a formal career program for environmental professionals. A career path system and wide dissemination of this information will improve worker motivation and morale. If there is no internal upgrading process, the morale of workers at lower levels will suffer. Managers can ensure the best performance from their workers through the promise of future advancement (31). It is shortsighted and far from cost-effective for the Army, after recruiting and training, to let its best workers walk out the door seeking career development and advancement.

There is a lack of appropriate incentives to retain an experienced environmental staff. Experienced staff members need to have sufficient challenges and rewards, and a measure of authority in their

TABLE 3-1 TOTAL EMPLOYMENT AND MEAN SALARIES FOR GENERAL SCHEDULE EMPLOYEES BY GRADE LEVEL

Grade	Total Employment	Mean Salary ($)
1	734	11,397
2	5,321	13,170
3	39,526	15,000
4	131,017	17,305
5	186,899	19,648
6	104,151	22,132
7	147,062	24,146
8	33,222	27,454
9	153,784	29,247
10	29,268	33,624
11	196,656	35,589
12	213,351	43,018
13	143,704	51,485
14	77,349	61,281
15	36,438	73,776
16	235	84,491
17	60	91,877
18	19	97,317
Total	**1,498,796**	**33,288**

Source: Federal Employees Almanac 1992, 39th Annual Edition, Federal Employees News Digest, Inc., Falls Church, 1992.

work. Installation environmental staffs currently do not, in general, have sufficient visibility to effectuate change nor do they have the authority to carry through original ideas, since they are buried in the management structure.

The education and experience of Army environmental staff should be appropriately match the job demands. A graduate with a bachelor's degree from a four-year university may actually be over-qualified for certain environmental staff positions. A bachelor's degree graduate hired for an

inappropriate position may become bored with the job duties and with no established career path in place to encourage his/her development, he/she may decide to quit. The turn-over rate for unchallenged employees in lower-level positions could be reduced by hiring individuals who have the minimum qualifications to perform the duties of environmental technicians (see section 5.1.1).

Another deficiency affecting retention of an adequate Army environmental staff is the absence of an environmental military occupational specialty outside of the Medical Service Corps as a profession for uniformed military. There is not a military billet for environmental professionals. The establishment of a specialized environmental billet might provide the leadership needed in this area. Although there seems to be a growing cadet interest in environmental studies at West Point, there is no environmental tenure track for the officers upon graduation.

3.4.3 Retention Incentive Examples from Industry

As companies in private industry are downsizing, they are struggling to determine what rewards and recognitions are available in the system now for their employees. Companies are beginning to offer more education and training. Flexible work hours are also used as an incentive for employees. More companies are employing management techniques that provide employees with a challenging and stimulating work environment along with the opportunities to take on more responsibility.

Innovative companies are involving younger employees in decision making, allowing them to develop and implement new ideas, and encouraging them to take calculated risks. Employees need to feel that their ideas are important and want to be given a certain amount of authority to carry them out.

4.0 CONCLUSIONS

The Army must recruit, train, and retain competent environmental professionals to ensure the operation of an efficient and effective environmental program. An inadequate environmental staff affects the Army's ability to properly formulate and execute program objectives. Currently the Army does not possess an adequate supply of qualified individuals to carry out its environmental management agenda. The Army needs to recruit more qualified environmental professionals and train existing environmental personnel in regulatory compliance issues.

National trends in environmental education portray a mixed picture for the Army's recruiting efforts. Trends in educating environmental scientists and engineers indicate increased interest by students, yet the supply of graduates is not keeping pace with demand. The Army will continue to face intense competition with government and industry for graduates in environmental science and engineering. However, the National Environmental Education Act of 1990 and university programs like the Tufts Environmental Literacy Institute promise to have a positive impact on the Army's environmental awareness campaign in the future, since an increasing number of new Army recruits can be expected to have a general understanding of environmental concepts.

The marketplace for environmental professionals will remain competitive through the 1990's. The current DoD hiring freeze will adversely affect recruitment of environmental professionals at the Department of Army and MACOM level. Competition from private industry for qualified environmental scientists and engineers may force the Army to improve salaries, job satisfaction, training, and professional status for these individuals. Several options exist for the Army to improve conditions in these areas and enhance retention of qualified environmental staff. Otherwise, a possible consequence of an inadequate Army environmental staff may be increased reliance upon contractual support.

Several recruiting options are available to the Army, including implementing a dedicated program for recruiting and training environmental interns, and bolstering current environmental staff with military personnel who possess education or experience in environmental disciplines and programs. The Army can improve environmental education, training, and career development for environmental professionals. Retention of Army environmental staff can be enhanced by studying the causes of employee turn-over and improving the potential for promotion and career advancement. These are only a few of the options available to the Army to improve recruitment, training, and retention of environmental staff. The section that follows provides a more complete discussion of options for future action.

5.0 OPTIONS FOR FUTURE ACTION

In the post-Cold War environment, the Army is facing substantial restructuring of its traditional roles and missions. At the end of this restructuring, the Army will have the smallest total number of divisions since before World War II. The base realignment and closure process is expected to continue over the next decade, and the process of charting out new national strategies will be a long one. Furthermore, restructuring will likely result in changes in the Army's organizational structure. However, the Army should not wait to address training and staffing needs until restructuring is complete. Near-term and mid-term options are available to the Army during the restructuring process.

The following options for future action (near-term, mid-term, and long-term) are presented to assist the Army in effectively recruiting, training, and retaining environmental professionals.

5.1 OPTIONS FOR RECRUITING QUALIFIED ENVIRONMENTAL PROFESSIONALS

5.1.1 Near-Term Recruitment Options

The Army could conduct a detailed study to analyze the environmental mission requirements and responsibilities at the DA, MACOM, and installation levels to determine immediate and long-term staffing needs.

The Army could estimate the number of specialized researchers that it needs and proactively recruit both military and civilian personnel with appropriate training to fill these positions.

The Army's general recruitment campaigns can be modified to improve the recruitment of environmental professionals. For example, students pursuing environmental careers could receive priority award of some ROTC scholarships. Similarly, the Army could actively recruit selected high school graduates to be hazardous waste technicians and nurture them into environmental professionals through Army civilian employee training and career programs. This initiative, coupled with specialized training for the current Army civilian and military work force, could be accomplished in the near-term.

The Center for Hazardous Materials Research (CHMR), a component of the University of Pittsburgh Trust, has recently established a technician training program that may fit well with the Army's needs. CHMR's two-year environmental technician training program was instituted in cooperation with the Allegahny County Community College District, and the first group of students are expected to graduate in August 1992. The program combines three semesters of academic study at local community colleges with one practicum semester of "hands on" experience at the CHMR facility. During the courses, students receive Occupational Safety and Health Administration (OSHA) health and safety certification and emergency response training. Upon successful completion of the program, students are awarded an associate of sciences degree and are qualified for such positions as field technicians, hazardous waste engineers, and site safety inspectors (35). The Army could recruit individuals graduating from the CHMR program to fill environmental technician positions. Another option would be to contact CHMR for their assistance in establishing similar technician training programs at Army installations and/or Army training facilities.

The Army could expand its publicizing of job openings to include advertising in professional journals. Most professional journals include a section for job announcements, and such advertising targets a select, qualified audience.

5.1.2 Mid-Term Recruitment Options

The Army should consider resourcing all environmental program personnel staffing requirements in the Program Planning Budget Execution System process. This should be a joint effort involving the Chief of Engineers, the Director of Installation Management, and the Assistant Secretary of the Army for Financial Management.

The Army could establish an additional skill identifier to effectively assess the available pool of military personnel with environmental education and experience. Department of Defense restructuring may complicate assessment efforts, however, the Army could assess personnel as soon as possible in order to recruit talent from within before it is lost. The Corps of Engineers, the Medical Service Corps, the Chemical Corps, and legal services are branches which possess military personnel with environmental education and experience.

The Army could aggressively recruit at university campuses which have environmental programs (reference Appendix A).

The Army could implement a dedicated program for environmental interns with the aim of recruiting, training, and placing high-quality interns.

The appropriateness of a candidate's education and experience related to the job requirements should be given adequate consideration in the hiring process. The Army could recruit environmental technicians for appropriate positions rather than candidates with B.S. degrees who may be overqualified for the work required.

The Army could establish an environmental career center for environmental staff. A career center could be used to display job openings and to provide career guidance.

The Army could develop required qualifications for all environmental staff positions that reflect the multidisciplinary nature of the job.

5.1.3 Long-Term Recruitment Options

The Army will likely face continued competition with private industry, other federal agencies, and the military services in recruiting trained environmental professionals. The Army could conduct a study to assess the benefits and liabilities of recruiting environmental professionals versus contracting for environmental expertise.

5.2 OPTIONS FOR ENVIRONMENTAL EDUCATION AND TRAINING

5.2.1 Near-Term Education and Training Options

In the near-term, the Army may want to focus its training efforts on basic regulatory compliance issues. In addition to, or in place of, providing its own training courses, the Army could look toward joint training sessions with EPA, DOE and other Federal agencies. Such training could be conducted cost-effectively and would give regulatory agencies a better sense of the dedication with which the Army is pursuing environmental excellence.

The Army could determine environmental training requirements for civilian personnel by job series.

The Army could formalize and support the DoD Environmental Training Coordination Group.

Army environmental staff could be encouraged to pursue advanced environmental science, management, and engineering degrees. The Army could acquire and disseminate information about graduate fellowships offered by the National Science Foundation and other such institutes to assist individuals with the cost of graduate study.

The Army could do more to encourage continuing education for environmental staff. Participation in seminars and workshops can be encouraged.

5.2.2 Mid-Term Education and Training Options

The Army could establish a multi-phased training program for civilian environmental staff under the Army Civilian Training Education Development System (ACTEDS). Continuing education should be made available for junior as well as senior staff.

The Army could establish graduate study financial assistance programs (for current Army civilian employees and military personnel) at the leading universities offering advanced environmental degrees (see Appendix A for university listing). Further, the Army could develop post doctoral research positions to support Army environmental research. Such assistance programs can continue until the Army has developed sufficient staff to complete (or at a minimum review/participate in) all identified environmental research requirements.

The Army could establish minimum proficiency requirements and testing for all environmental personnel and key officers involved in environmental matters and make such proficiency mandatory for promotion.

The Army could encourage environmental staff to participate in the NAEP certification program and NREP registration program.

The Army could enhance the use of employee exchange programs with other federal or state agencies.

5.2.3 Long-Term Education and Training Options

In the long run, the Army could look forward to developing a Joint Environmental Training Institute with the other Federal agencies. This joint institute could more cost-effectively train environmental professionals in the variety and depth of coursework necessary. Such a joint training program could also improve inter-agency communication.

The Army could establish an environmental engineering curriculum at West Point. West Point has long been recognized for their engineering excellence. In addition, West Point could develop and offer degree programs in environmental engineering/science and environmental policy. Offering such degrees will provide the Army with a large pool of qualified individuals from which to build a nationally recognized environmental program.

A parallel structure could be established in the Army's ROTC program. The program would follow the same path as the work performed at West Point. The Army could require minimum training in environmental issues in all ROTC programs. In addition, all engineer majors enrolled in senior ROTC

programs (especially scholarship ROTC students) could be encouraged to take environmental engineering courses.

To support the work begun at West Point and in the ROTC programs, the Army could establish a large-scale environmental institute. This institute would be the center for all environmental training and would bring together environmental professionals from other Federal agencies to share ideas and experiences. In addition, all trainers at this or any other Army institute could be required to receive certification from the Army on their ability to teach the curriculum.

The Army could increase coordination between Army environmental staff and other governmental agencies and private industry to share knowledge and expertise.

The Army could establish a technician training program for appropriate environmental positions.

5.3 OPTIONS FOR RETENTION OF ARMY ENVIRONMENTAL STAFF

5.3.1 Near-Term Retention Options

The Army could conduct a study to determine the turn-over rate of environmental personnel and the reasons stated for leaving. Such a study would provide valuable information to assist the Army in developing retention incentives for its personnel. It should be noted that recommended actions resulting from such a study may require rule changes at the Office of Personnel Management and/or Congressional action to implement.

The Army could encourage environmental staff to become members of professional societies. Participation in professional associations is an important part of professional development. Contacts made in professional societies help employees establish networks for exchanging ideas. Participation of employees as officers in organizations gives them "hands on" management and leadership training that may not be available to them as part of their current position.

The Army could provide subscriptions to national environmental publications and professional journals for Army environmental staff. Appendix D provides information on selected environmental periodicals appropriate for consideration. Environmental staff can be encouraged to contribute by submitting articles and sharing success stories.

5.3.2 Mid-Term Retention Options

The potential for promotion and career advancement is an important factor in employee job satisfaction. The Army could improve opportunities for Army environmental personnel to attain higher GS/GM levels. This could be accomplished by developing GS career ladders which are initiated and "top out" at more senior GS, or GM, levels. The first step would be to study the tasks and skills needed in each position. Credentials required for each position can be selected and a detailed job description prepared for each position. Such an analysis can lead to discovering possible overlaps between positions or how positions could be more economically designed. It can also assist in determining what training programs will be needed to move people up to their next level. Professionals following the career path could be awarded increasingly responsible assignments, and their progress should be closely monitored. Assignments could also provide flexibility of new locations to broaden the individual's experience and retain his/her interest.

An Army environmental career program could include a 2-year track aimed at training environmental technicians for lower GS positions. The 2-year track could provide the opportunity for environmental technicians to progress into the advanced environmental professional program with appropriate training and experience.

The study in the near-term could recognize opportunities for enhancing on-the-job success leading to increased job satisfaction.

5.3.3 Long-Term Retention Options

For military personnel, the Army could create an environmental military occupational specialty. This idea has already been addressed by the DA, ODCSPER with the determination that it is not needed. However, the decision should be reviewed.

Another means of maintaining staff might include placing more emphasis on special awards for environmental protection achievements. This is already being done within some MACOMS, notably AMC. Additionally, the Army could aggressively pursue providing opportunities for career growth to environmental professionals by establishing "centers for excellence in environmental sciences and technology" which Army environmental officials will be encouraged to work at on a detail basis as a form of "on-the-job" enhancement. As an example, centers for excellence might include the Corps of Engineer Divisions and research labs, AEHA, THAMA, or other designated Army agencies.

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APPENDIX A

FOUR-YEAR UNIVERSITIES OFFERING ENVIRONMENTAL ENGINEERING GRADUATE PROGRAMS

University Name	Degrees Offered[a]
University of Akron	M
University of Alaska-Fairbanks	M
University of Alberta	M
University of Arizona	M
University of Arkansas	M
Auburn University	M
Bucknell University	M
University of California, Berkele	M, D
University of California, Davis	M
University of California, Los Angeles	M, D
University of California, Santa Barbara	M, D
California Institute of Technology	M, D
California State University, Fresno	M
California State University, Sacramento	M
Carnegie Mellon University	M
University of Central Florida	M, D, O
University of Cincinnati	M, D
Clarkson University	M
Clemson University	M, D
University of Colorado at Boulder	M, D
Colorado State University	M, D
Columbia University	M, D, O
University of Connecticut (Storrs)	D
Cornell University - Agricultural Engineering	M, D
Cornell University - Civil/Environmental Engineering	M, D
Dartmouth College	M, D
University of Delaware	M
Drexel University	M, D
Duke University	M, D
University of Florida	M, D, O
Florida Institute of Technology	M
Florida International University	M
George Washington University	M, D, O
Georgia Institute of Technology	M, D
University of Hawaii at Manoa	M
University of Houston	M, D
Howard University	M
University of Illinois at Urbana	M, D
Illinois Institute of Technology	M, D
University of Iowa	M, D
Iowa State University of Science and Technology	M, D
The John Hopkins University	M, D

APPENDIX A (cont.)

University Name	Degrees Offered[a]
University of Kansas	M
University of Kentucky	M
Lehigh University	M
Louisiana State University	M, D
Loyola Marymount University	M, D
University of Maine (Orono)	M, D
Manhattan College	M
Marquette University	M, D
University of Maryland	M
University of Massachusetts at Amherst	M
University of Massachusetts at Lowell	M
Massachusetts Institute of Technology	O
McGill University	M, D
The University of Michigan - Ann Arbor	M, D, O
Michigan State University	M, D
Michigan Technology University	M, D
University of Minnesota	M
Mississippi State University	M, D
University of Missouri - Columbia	M, D
University of Missouri - Rolla	M
Montana College of Mineral Sciences and Technology	M
Montana State University	M
University of Nevada, Las Vegas	M
University of New Brunswick (Fredericton)	M, D
University of New Hampshire	M
University of New Haven	M
State University of New York at Buffalo	M, D
The University of North Carolina at Chapel Hill	M, D
The University of North Carolina at Charlotte	M
Northeastern University	M
Northwestern University	M, D
The University of Notre Dame	M, D
The Ohio State University	M
University of Oklahoma	M, D
Oklahoma State University	M, D
Oregon Graduate Institute of Science and Technology	M, D
Oregon State University	M, D
The Pennsylvania State University	M, D
University of Pennsylvania (Pittsburg)	M, D
Polytechnic University, Brooklyn Campus	M, D, O
Princeton University	M
University of Puerto Rico	M
Purdue University	M
University of Regina	M

APPENDIX A (cont.)

University Name	Degrees Offered[a]
Rensselaer Polytechnic Institute	M, D
University of Rhode Island	M, D
Rice University	M, D
San Jose State University	M
University of South Florida	M, D, O
University of Southern California	M, D
Southern Illinois University at Carbondale	M
Stanford University	M
Stevens Institute of Technology	M
Syracuse University	M
The University of Tennessee, Knoxville	M
The University of Texas at Austin	M
The University of Texas at El Paso	M
Texas A&M University (College Station)	M, D
Texas Tech University	M
University of Toronto	M, D
Tufts University	M
Utah State University	M, D, O
Vanderbilt University	M, D
Villanova University	M
Virginia Polytechnic University	M, D
University of Washington	M, D
Washington State University	M, D
Wayne State University	M
West Virginia University	M
The University of Wisconsin-Madison	M, D
Worcester Polytechnic Institute	M
University of Wyoming	M

[a] M = master's degree; D = doctorate; O = other advanced degree

Source: Association of Environmental Engineering Professors, Register of Environmental Engineering Graduate Programs, sixth edition, 1989 (32) and Peterson's Guide to Graduate and Professional Programs: An Overview 1992, 26th edition, Peterson's Guides, Princeton, 1992 (33).

APPENDIX B

NATIONAL ASSOCIATION OF ENVIRONMENTAL PROFESSIONALS FUNCTIONAL AREAS FOR CERTIFICATION

Environmental Planning -- including policy, criteria, and decision making;

Environmental Documentation -- including preparation, processing, and review;

Environmental Assessment -- including review, evaluation, and reporting of socio-economic and natural environmental impacts and analysis of associated costs, risks and benefits, and the design of mitigation measures;

Environmental Operation -- including techniques for reducing adverse environmental impacts, and monitoring environmental effects;

Environmental Research and Education -- including investigation of theoretical and applied aspects of all areas of the environmental profession for the purpose of developing and applying new skills.

Source: National Association of Environmental Professionals (NAEP), application information for certification as an environmental professional, revised December 1990 (19).

APPENDIX C

NATIONAL REGISTRY OF ENVIRONMENTAL PROFESSIONALS REGISTRATION LEVELS AND REQUIREMENTS

Registered Environmental Manager (REM) -- Highest professional management level of NREP registration. An exam is mandatory. Requires a bachelor's degree in environmentally-related discipline and 3 years work experience directly related to environmental engineering, health, science, or management.

Registered Environmental Professional (REP) -- Special intermediate level program. Requires an advanced educational degree in a field of science or technology directly applicable to the environmental field; or current certification in one of the NREP Board-approved specialized certification programs:

- Certified Industrial Hygienist
- Certified Environmental Trainer
- Certified Health Physicist
- Certified Safety Professional
- Certified Environmental Professional
- Certified Hazardous Materials Manager
- American Academy of Env. Engineers Diplomate
- California Registered Environmental Assessor
- Registered or Certified Professional Geologist
- Certified Hazardous Waste Specialist

Associate Environmental Professionals (AEP) -- Entry level program of professional environmental registration. An examination is mandatory. Requires 2 years in a Bachelor's degree program, such as environmental engineering, health/science, environmental management, or hazardous materials management; no work experience is necessary.

Environmental Technician (ET) -- Certificate recognition program designed only to permit an individual to participate in NREP's programs. This program is not professional registration, but is a first step toward professional recognition.

Certified Environmental Auditor (CEA) -- Specialty certification program to credential professionals conducting environmental compliance and risk audits. An exam is mandatory. Requires a bachelor's degree in environmentally-related discipline and 2 years work experience directly related to environmental audits of operating facilities and processes.

Registered Environmental Property Assessor (REPA) -- Specialty registration for persons engaged in the inspection and evaluation of environmental risk in real property. Requires a bachelor's degree in environmentally-related discipline and 2 years work experience directly related to environmental property transfer assessments.

Registered Environmental Laboratory Technologist (RELT) -- Specialty registration for persons engaged in the laboratory management and/or analysis of environmental samples. Requires a bachelor of science degree and 2 consecutive years of laboratory work conducting research and/or analysis of environmental contaminants.

Source: National Registry for Environmental Professionals, 1990 (20).

APPENDIX D

SELECTED ENVIRONMENTAL PERIODICALS AND JOURNALS

ENVIRONMENTAL BUSINESS JOURNAL (ISSN 1045-8611)
Annual subscription rate: $395; Issued monthly
Environmental Business Publishing, Inc.
P.O. Box 371769
San Diego, CA 92137-1769 Tel: (619) 295-7685
Description: Activities in the environmental and pollution generating industries to minimize environmental effects.

ENVIRONMENTAL COMPLIANCE UPDATE
Annual subscription rate: $156; Issued monthly
High Tech Publishing Company
P.O. Box 1923
Brattleboro, VT 03501 Tel: (802) 254-3539
Description: Identifies and analyses environmental issues of interest to the business community, and monitors the economic impact of environmental compliance law, as well as developments in legislation, court decisions and technology.

ENVIRONMENTAL ENGINEERING SELECTION GUIDE (ISSN 0896-3827)
Annual subscription rate: Free; Issued annually
American Academy of Environmental Engineers
130 Holiday Court, Ste. 100
Annapolis, MD 21401
Description: Consultant directory.

ENVIRONMENTAL IMPACT ASSESSMENT REVIEW (ISSN 0195-9255)
Annual subscription rate: $138; Issued quarterly
Elsevier Science Publishing Co., Inc.
655 Avenue of the Americas
New York, NY 10010 Tel: (212) 989-5800
Description: Highlights advances in impact assessment, environmental decision making, and the resolution of environmental disputes.

ENVIRONMENTAL MANAGER (ISSN) 1043-7863)
Annual subscription rate: $160; Issued monthly
Executive Enterprises Publications Co., Inc.
22 W. 21st Street
New York, NY 10010-6904
Description: Features news and case studies dealing with environmental problems such as hazardous waste cleanups, waste minimization, underground storage tank leaks, and clean air standards.

APPENDIX D (cont.)

ENVIRONMENTAL PROFESSIONAL (ISSN 0191-5398)
Annual subscription rate: $95; Issued quarterly
National Association of Environmental Professionals
P.O. Box 15210
Alexandria, VA 22309-0210 Tel: (207) 283-0171
Description: The official journal of the National Association of Environmental Professionals. Provides an open forum for the discussion and analysis of significant environmental issues.

GREEN ENGINEERING (ISSN 0960-8796)
Annual subscription rate: $188; Issued monthly
Mechanical Engineering Publications, Ltd.
Northgate Avenue, Bury Street
Edmunds, Suffolk, IP32 6BW, England Tel: 0284-763277
Description: A current awareness bulletin focusing on environmental issues for the engineering profession.

JOURNAL OF ENVIRONMENTAL ENGINEERING (ISSN 0733-9372)
Annual subscription rate: $108; Issued bi-monthly
American Society of Civil Engineers, Environmental Engineering Division
345 E. 47th Street
New York, NY 10017-2398 Tel: (212) 705-7288
Description: Reports solution of problems involving environmental sanitation and considers the social and environmental impact of those solutions.

ENVIRONMENTAL PROGRESS (ISSN 0278-4491)
Annual subscription rate: $100; Issued quarterly
American Institute of Chemical Engineers
345 E 47th Street
New York NY 10017-2398 Tel: (212) 705-7663
Description: Covers current technological advances with an emphasis on practical applications of chemical engineering to pollution abatement.

Source: Ulrich's International Periodicals Directory 1991-92, 30th edition, Reed Publishing (USA) Inc., New Providence, 1991 (34).